A report for the committee of Hargrave Village Hall: Energy efficiency considerations in the short, medium and long term

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Summary

Hargrave Village Hall is the primary community hub in the village of Hargrave on the outskirts of Bury St. Edmunds in Suffolk. It has eight regular groups and is also used for parish council meetings and elections. The building was originally constructed in 1926 and has seen some refurbishments including disabled access and toilets, double glazing, electrical improvements and insulation.

The committee approached the Suffolk Climate Change Partnership as they are looking to make the hall viable and fit for purpose to remain the centre of the community in Hargrave into the next few decades, recognising the importance of comfort as well as financial and environmental sustainability in making this a reality.

This report recommends actions categorised into short, medium and long term considerations that will minimise energy consumption and therefore reduce cost and carbon footprint. Each action includes estimates of savings and payback to provide a basis for decision making on the future of the asset.

Contents

Existing energy consumption and carbon footprint

Electricity bills provided by the treasurer have been used to estimate Hargrave Village Hall's annual electricity consumption. Using Defra's most recently published carbon conversion factors (2018), the associated carbon footprint of this usage has been calculated to be 1.0 tonne of carbon dioxide equivalent per year (Table 1).

Table 1. Estimated annual electricity consumption and associated carbon footprint of Hargrave Village Hall

Emission Source	Consumption (kWh/year)		Annual Cost (£/year)	Annual Emissions (tCO_2e/year)		Total Emissions (tCO_2e/year)
				Scope 2	Scope 3	
Electricity	2,851	kWh	£640	0.8	0.2	**1.0**

During the review, all electrical equipment was noted, alongside approximate frequencies of use, to calculate an estimated breakdown of electrical consumption into categories (Figure 1; Table 2).

Table 2 (left). Estimated annual electricity consumption, cost and associated carbon footprint of electrical equipment at Hargrave Village Hall

	kWh /year	£ /year	tCO_2e /year
Lighting	219	£49	0.1
Catering Equipment	175	£39	0.1
Electric Heating Equipment	1,972	£443	0.7
Electric Hot Water Heating Equipment	171	£38	0.1
Refrigeration Equipment	13	£3	0.0
Dehumidifiers	105	£24	0.0
Other Equipment	4	£1	0.0
Unaccountable	193	£43	0.1
	2,851	**£640**	**1.0**

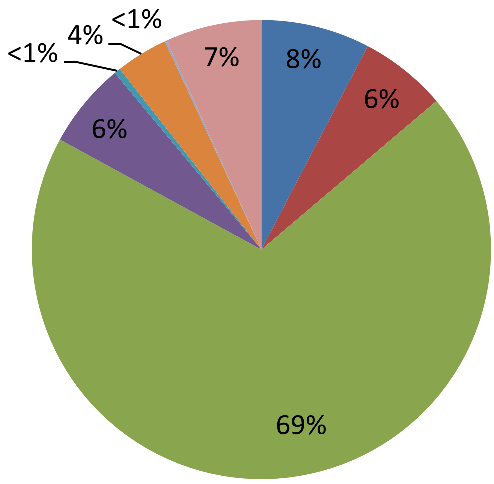

Figure 1 (right). Proportions of electricity consumption attributable to categories in Table 2, with corresponding colours and in clockwise order

The primary draw of electricity at Hargrave Village Hall, at an estimated 69%, is the heating equipment, with other main categories being roughly similar (lighting 8%, catering equipment 6%, hot water heating equipment 6%, dehumidifiers 4%). Unaccountable consumption (7%) is the excess electricity demand that has not been accounted for, and is likely to be a consequence of underestimated frequencies of use and/or missed equipment. Full details of estimated electricity consumption are detailed at the end of this report.

Short-term considerations

These recommendations are for the building in its existing condition and are the easiest and cheapest actions to minimise costs and improve comfort.

Action 1 –Replace lighting with LED equivalents

Key estimated figures:

Cost saving - £35 per year
Carbon saving – 0.1tCO_2e per year
Capital cost - £560
Payback – 16.0 years

At present, lighting at Hargrave Village Hall is made up of a mixture of fluorescent tube fittings and regular GLS (general lamp shape) bulbs. It has been estimated that this is responsible for 8% of annual electricity consumption (219kWh, £49 and 0.1tCO_2e).

LED lighting provides the same light output but uses less than half of the electricity of the existing fittings. LEDs also have a much longer lifespan so offer additional savings in the long term. The fluorescent tube fittings should be replaced by a qualified electrician but the regular GLS bulbs (i.e. screw or bayonet fixtures) can be replaced by hand.

It is estimated that replacing all lighting with LED, as detailed in Table 3, could save 156kWh per year, worth £35 and 0.1tCO_2e. Wattages of lamps and replacements are listed within. Additional savings from not needing to replace lamps as frequently are also expected, but not included.

Table 3. Estimated savings from replacing lighting with LEDs at Hargrave Village Hall (note that carbon footprint figures are rounded to 1 decimal place so 0.0 does not actually mean zero)

Room	Current lamp	Total no. lamps	kWh/ yr	£/ yr	tCO_2e / yr	Replacement lamp	Total no. lamps	kWh / yr	£/ yr	tCO_2e / yr
Main Hall	5 Foot T12 (80W)	3	119	£27	0.0	5 Foot LED (24W)	3	29	£6	0.0
Main Hall	5 Foot T8 (58W)	1	27	£6	0.0	5 Foot LED (24W)	1	10	£2	0.0
Entry	6 Foot T8 (70W)	2	32	£7	0.0	6 Foot LED (30W)	2	12	£3	0.0
Toilets and Store	48W GLS	6	5	£1	0.0	10W LED	6	1	£0	0.0
Main Hall	60W GLS	8	9	£2	0.0	10W LED	8	2	£0	0.0
Kitchen	5 Foot T8 (58W)	2	27	£6	0.0	5 Foot LED (24W)	2	10	£2	0.0
Current totals			**219**	**£49**	**0.1**	**Replacement totals**		**63**	**£14**	**0.0**
						Savings		**156**	**£35**	**0.1**

The estimated costs for this action are derived from assumptions of material and labour costs detailed in Table 4.

Table 4. Estimated costs of LED lighting upgrade

Room	Replacement lamp	Total no. lamps	Access	Cost per lamp	Installation cost per fitting	Total lamp cost	Total fitting cost	Total cost
Main Hall	5 Foot LED (24W)	3	Low	£25	£35	£75	£105	£180
Main Hall	5 Foot LED (24W)	1	Low	£25	£35	£25	£35	£60
Entry	6 Foot LED (30W)	2	Low	£30	£35	£60	£35	£95
Toilets and Store	10W LED	6	None	£10	None	£60	None	£60
Main Hall	10W LED	8	None	£10	None	£80	None	£80
Kitchen	5 Foot LED (24W)	2	Low	£25	£35	£50	£35	£85
Total costs						**£350**	**£210**	**£560**

Action 2 –Increase depth of ceiling insulation if possible

Key estimated figures:

Cost saving - £27 per year
Carbon saving – <0.1tCO_2e per year
Capital cost - £1,000
Payback – 36.7 years

The heating system at Hargrave Village Hall is a mixture of radiant (which heats people and objects directly next to the heater) and convection (which heats the air). Having both types of system in the same room is unusual, with radiant heaters often being used in poorly insulated buildings where convector heaters can end up heating air that is very quickly being lost from the building. Having both helps ensure the building is at a comfortable temperature, but consequently electric heating is a significant expenditure, estimated to account for 69% of annual electricity demand (1,972kWh, £443 and 0.7tCO_2e).

Although not entirely applicable to the village hall due to the mixture of radiant and convector heating, basic heat loss calculations have been undertaken to estimate the heat loss proportions from different parts of the building fabric (Table 5). The results assume that the village hall is heated entirely with convector heaters, and so the consumption and cost figures (Table 6) don't match up with actual figures, but are intended to provide an indication of the relevant importance of insulating parts of the building fabric.

Table 5. Estimated heat losses from Hargrave Village Hall

Element	U-Value (W/m²k)	Surface Area of Component (m²)	W/m2°C	% Heat Loss
Wall	2.2	90	198	38%
Roof	0.45	146	66	13%
Floor	1	133	133	25%
Windows	3.1	12	37	7%
Doors	3.1	2	6	1%
Ventilation	0.33	399	86	16%
Totals			**526**	**100%**

Table 6. Estimated electricity consumption associated with heating Hargrave Village Hall by electric convector heating

Heating Systems Annual Energy Consumption kWh	2,181
Annual Heating Cost	£489
Annual Associated Carbon Emissions	0.8

As the projected figures for all convector heating in Table 6 are not too much greater than the actual spend, it is assumed that most users turn on the convector heaters in addition to the radiant heaters.

At present, the only building fabric measure that is deemed worth considering financially is to top up the insulation above the ceiling if there is room to do so. It is thought there may be around 100mm of insulation and it is recommended to top this up to around 270mm if space permits. The heat loss calculations were undertaken reflecting a reduction in U-Value (measure of heat loss rate through a material) from 0.45 (Building Regulations 1992) to 0.25 (Building Regulations 1995 onwards) in the roof and the estimated savings are summarised in Table 7.

Table 7. Estimated savings from topping up insulation above the ceiling

Heating Energy Saved (kWh)	121
Percentage Energy Saved	6%
Annual Heating Cost Saving	£27
Annual Associated Carbon Emissions Saving (tCO_2e)	<0.1

It is estimated that this would cost in the region of £1,000, which equates to around £6.80 per m^2. Other building fabric recommendations should be considered if an extension or wider renovations are moved forward.

Medium-term considerations

The committee are interested in extending the building out to the front where possible to provide more space; these recommendations are suggested as part of this large project to maximise cost effectiveness.

Action 3 – Insulate external walls and install new windows

Key estimated figures:

Cost saving - £216 per year
Carbon saving – 0.3tCO_2e per year
Capital cost - £16,000
Payback – 80.7 years

It is understood that the walls are solid and there is no scope for cavity wall insulation. With an estimated 38% of heat losses attributable to the walls, this is a key area to address to reduce future heating costs. Any extension would be well-insulated to meet modern regulations, but the only options for the existing walls would be to internally or externally clad the walls. It is felt that the most appropriate would be external to prevent loss of internal space, and the finish could be in keeping with the extension.

Insulating the walls with polyisocyanurate (PIR) board is estimated to cost in the region of £100 per m^2 which over an estimated area of 90 square meters has been rounded up to £10,000. This is expected to reduce the U-Value of the walls from 2.2 to 0.3, the latter being a requirement for external insulation – see http://www.kingspaninsulation.co.uk/buildingregulations/. Savings can be seen in Table 8.

Table 8. Estimated saving from external wall insulation

Heating Energy Saved (kWh)	830
Percentage Energy Saved	38%
Annual Heating Cost Saving	£186
Annual Associated Carbon Emissions Saving (tCO_2e)	0.3

The windows are likely to need replacement, having been installed in 1992. Triple glazing would provide the best U-Value and quotes should be obtained to compare double with triple grazing. A reduction in U Value from 3.1 to 0.8 (see https://www.theecoexperts.co.uk/triple-glazing-guide-costs) is expected to yield saving summarised in Table 9 and cost around £500 per m^2 installed over an estimated area of 12 square meters.

Table 9. Estimated saving from triple glazing.

Heating Energy Saved (kWh)	255
Percentage Energy Saved	12%
Annual Heating Cost Saving	£57
Annual Associated Carbon Emissions Saving (tCO_2e)	0.1

Action 4 – Replace heating system with Air Source Heat Pumps

Key estimated figures:

Cost saving - £194 per year
Carbon saving – 0.3tCO_2e per year
Capital cost - £8,000
Payback – 41.2

It is recommended that the village hall consider Air Source Heat Pumps after it has undertaken insulation works (it is not considered worthwhile in the current building fabric). ASHPs work like a reverse refrigeration system and use heat in the outside air to maximise efficiency in the system which can provide heating or cooling. Heat pumps (both air and ground-source) can be linked up to a wet central heating system, however this would require a lot of infrastructure (pipes and radiators) to be installed at significant expense, and given the size of the hall it is felt that 'air-to-air' units which deliver warm and cool air like an air conditioning system (Figure 2) would be much more cost effective. ASHPs have external units (large fans) and internal units to deliver the air. Modern systems are thought to be quiet and to run at around 300% efficiency in a well-insulated building (i.e. 1kWh of electricity yields 3kWh of useful heat, compared with 100% for the existing system) so potential for savings is high.

Figure 2. Components of an ASHP system

Controlling the system would also be a lot more efficient. It would be set on a timer to reflect usage to thermostatically heat below a certain temperature, and cool above a certain temperature, with a gap in between to prevent the system constantly correcting itself. Users could also change the target temperature (e.g. an exercise class may want cooler temperatures than a parish council meeting).

Savings are expected to be around two-thirds of the heating demand compared to the system remaining the same in the newly insulated building (Table 10).Costs are expected to be in the region of £8,000, which is estimated to be significantly cheaper than installing a wet ASHP system or Ground Source Heat Pump system.

Table 10. Estimated saving from ASHP heating

Heating Energy Saved (kWh)	865
Percentage Energy Saved	67%
Annual Heating Cost Saving	£194
Annual Associated Carbon Emissions Saving (tCO_2e)	0.3

Long-term considerations

This action is to be considered into the long-term future, and would be of most benefit if the hall is used more frequently during daylight hours.

Action 5 – Consider solar PV and battery storage

Cost saving - £320 per year
Carbon saving – 0.5tCO_2e per year
Capital cost - £10,000
Payback – 31.3

At present, the village hall is used for almost 400 hours per year and is expected to be in use for only around 5-10% of total daylight hours. This means that installing solar panels is unlikely to offer a worthwhile return on investment. However, if it is sized appropriately and includes a battery system to charge up and be available for use when the panels are not generating, it may be worth considering. A set up like this would cost in the region of £10,000, and for the sake of argument if it were to reduce current electricity demand by half (assuming some battery loss), it would save £320 per year. This is however very 'finger in the air' and should not be used as a means of making a final decision, and professional installers should be contacted to quote on suitable size and specification if this is taken forward. Note that the more frequently used the village hall becomes, the more cost-effective this action will be. It is advised that all of the other measures are taken first to maximise comfort and minimise electricity demand, so the panels are not being used to offset consumption that could be otherwise avoided. This more welcoming facility is also more likely to get the usage that would make investing in solar panels more worthwhile. The internal set up of this kind of system would look like that shown in Figure 3.

Figure 3. A solar battery set up in another village hall

Funding opportunities

There are some funds overleaf which may be worth applying for to contribute towards the costs of the recommended measures. Your advisor can help by reviewing applications before they are sent off and providing information to include within (i.e. cost and carbon saving benefits). When the charity is seeking funding for large scale works, a full funding search can be undertaken by your advisor to find the most appropriate funding avenues at the time.

UK Power Networks Power Partners Fund - https://www.cse.org.uk/projects/view/1356

This fund offers up to £20,000 towards measures and is due to open up for another round in summer 2019. Criteria regarding deprivation, vulnerability and isolated communities are important considerations, in addition to the energy efficiency and environmental improvements. This one may be worth applying to for the medium-term considerations.

Green Suffolk Fund - http://www.greensuffolk.org/green-communities/grants-and-funding-opportunities/greensuffolkfund/

Up to £2,000 (max. 50% of project costs) towards energy efficiency measures. May be appropriate for short-term considerations.

West Suffolk Greener Business Grant -
https://www.westsuffolk.gov.uk/Business/Start_and_Grow_Your_Business/businessenergy.cfm

Up to £1,000 towards energy efficiency measures. May be appropriate for short-term considerations. Application form can be sent over separately by your advisor.

Tesco Bags of Help -
https://www.groundwork.org.uk/Sites/tescocommunityscheme/pages/Category/boh-grant-for-project-tes

Either £4,000, £2,000 or £1,000 awarded to successful applicants, depending upon public vote. All projects of community benefit considered.

Detailed electricity consumption estimates

The following tables summarise the information used to estimate electricity consumption by category in Table 2. 'Frequency of use' is multiplied by the number of hours to factor down consumption where it is not expected to be in use all of the time the building is occupied.

Lighting												
Room	Lighting Type	Lamp	No. fittings	No. lamps per fitting	Total no. lamps	Watts	Ballast	Freq. of use	Hours / year	kWh / yr	£/ yr	tCO_2e / yr
Main Hall	Fluorescent	5 Foot T12	3	1	3	80	1.3	100%	381	119	£27	0.0
Main Hall	Fluorescent	5 Foot T8	1	1	1	58	1.2	100%	381	27	£6	0.0
Entry	Fluorescent	6 Foot T8	1	2	2	70	1.2	50%	381	32	£7	0.0
Toilets and Store	GLS	48W GLS	6	1	6	48	1	5%	381	5	£1	0.0
Main Hall	GLS	60W GLS	8	1	8	60	1	5%	381	9	£2	0.0
Kitchen	Fluorescent	5 Foot T8	1	2	2	58	1.2	50%	381	27	£6	0.0
										219	**£49**	**0.1**

Catering Equipment								
Room	Item	No.	Wattage	Frequency of use	Hours/year	kWh/ year	£/ year	tCO_2e/ year
Kitchen	Kettle	3	2500	2.5%	381	71	£16	0.0
Kitchen	Oven	1	5000	5.0%	381	95	£21	0.0
Kitchen	Microwave	1	850	2.5%	381	8	£2	0.0
						175	**£39**	**0.1**

Electric Heating Equipment								
Room	Item	No.	Wattage	Frequency of use	Hours /year	kWh/ year	£/ year	tCO_2e / year
Main Hall	Newlec NL10 Fan Heaters	4	3000	22.5%	381	1,029	£231	0.4
Main Hall	Newlec Curtain Fan Heaters	2	2000	22.5%	381	343	£77	0.1
Main Hall	Claudgen Radiant Heaters	3	2000	22.5%	381	514	£115	0.2
Main Hall	Dimplex Radiant	1	1000	22.5%	381	86	£19	0.0
						1,972	**£443**	**0.7**

Electric Hot Water Heating Equipment								
Room	**Item**	**No.**	**Wattage**	**Frequency of use**	**Hours /year**	**kWh/ year**	**£/ year**	**tCO_2e / year**
Kitchen	Ariston Undersink Heater	1	3000	10%	381	114	£26	0.0
Toilets	Redring Instant	2	3000	2.50%	381	57	£13	0.0
						171	**£38**	**0.1**

Refrigeration Equipment								
Room	**Item**	**No.**	**Wattage**	**Frequency of use**	**Hours/year**	**kWh/ year**	**£/ year**	**tCO_2e/ year**
Kitchen	Fridge	1	100	33%	381	13	£3	0.0
						13	**£3**	**0.0**

Dehumidifiers								
Room	**Item**	**No.**	**Wattage**	**Frequency of use**	**Hours/year**	**kWh/ year**	**£/ year**	**tCO_2e/ year**
All	Dehumidifier	2	320	43%	381	105	£24	0.0
						105	**£24**	**0.0**

Other Equipment								
Room	**Item**	**No.**	**Wattage**	**Frequency of use**	**Hours/year**	**kWh/ year**	**£/ year**	**tCO_2e/ year**
Main Hall	Ceiling Fans	2	50	5%	381	2	£0	0.0
Toilets	Extraction	2	50	5%	381	2	£0	0.0
						4	**£1**	**0.0**

Electricity consumption and carbon footprint assumptions

Electricity	Electricity consumption has been calculated based upon billing data provided from 26/03/2018 to 05/04/2019 and the carbon footprint using Defra's most recent (2018) conversion factors (Scope 2 - 0.28307kgCO_2e/kWh, Scope 3 - WTT - 0.04198kgCO_2e/kWh, T&D - 0.02413kgCO_2e/kWh, WTT of T&D - 0.00358kgCO_2e/kWh.)